EZMETROLOGY

SpeedPod | Datasheet

Contents

1. Introduction

SpeedPod is the latest generation measurement device for fast and highly accurate characterization of door systems and closing efforts.

SpeedPod's smart operation and smart technology provide a measurement gauge that is both powerful and easy to use.

SpeedPod can be used on all type of doors to characterize not only minimum closing speed but also hinge tip, friction, opening speed and, for analysis, full raw data of the movement.

2. Smart Features

2.1 SpeedPod Features

Figure 1. Key features illustrated for SpeedPod measurement device

2.2 EZ Operation

SpeedPod integrates several features to provide a gauge which is both intelligent and easy to use:

Rapid Mounting: Single-lever operated suction cup enables the device to be mounted in the blink of an eye to any type of smooth surface—glass, metals, and plastics. The same suction cup lever also allows for a quick-release feature for easy dismounting.

Robust Installation: SpeedPod can be mounted in any orientation and any location to determine the accurate door movement and characteristics.

Smart Movement Detection: The smart movement detection algorithm keeps track of the location, movements, and measurements in progress. This allows the device to manage the session, guide operators, complete the measurement, and validate all requirements.

Real-time LED feedback: Four multi-color LEDs instantly communicate the measurement state of the device. The smart positioning algorithm indicates device status: mounted, closed, opening, opened, closing, latched or not latched. Additional lights show measurement pass/fail, charging/powered, and mounted/dismounted states.

Automatic Latch Detection: A specific collection of characteristics is used by the device to determine if a door is latched or not latched during a measurement cycle. This intelligence eliminates the need for button pressing or dependency on feedback from the user on the state of the door after closing.

Finished Condition: The device will provide feedback to the user and indicate when sufficient data has been collected for a complete, valid measurement.

2.3 Advanced Technology

SpeedPod is a new generation, handheld instrument that integrates the latest available technology to provide fast, lightweight, and highly accurate measurements of door systems.

3D Inertial Sensor: An industrial inertial sensor (3D gyroscope and 3D accelerometer) registers the movement when mounted to a moving door. The multi-axis sensing provides the benefits of mounting the device in any position and orientation on the surface during measurements of door closing efforts.

Dual Core- Real Time Processing: The powerful on-board processor chip enables button-free operation. The intelligent algorithms will determine if the device has been mounted on a door and start the measurement automatically without any further user interaction. The device will automatically determine if the door has been latched or not latched.

Li-Ion Battery: Energy dense and lightweight for long-lasting mobile operation with a fast-charging docking station.

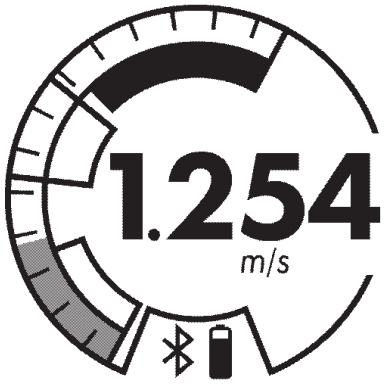
2.4 Compatible Door Types

SpeedPod can be used on all door types.

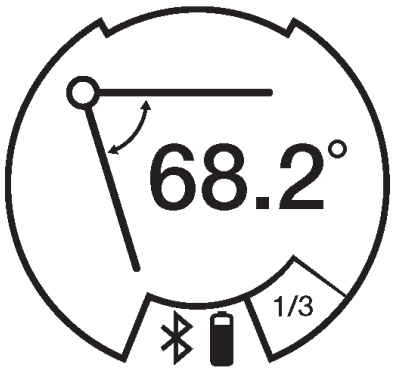
The basic model has the functionality that works on all classic hinged doors. The optional universal Hinge module enables the measurements on any hinge orientations such as liftgates, tailgates, trunks, frunk, falcon, swan and more. A special module is available for sliding and pocket doors.

3. Measurement Performance

3.1 Metrics

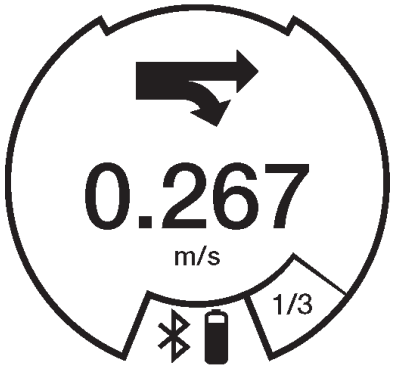


Closing/Opening Speed

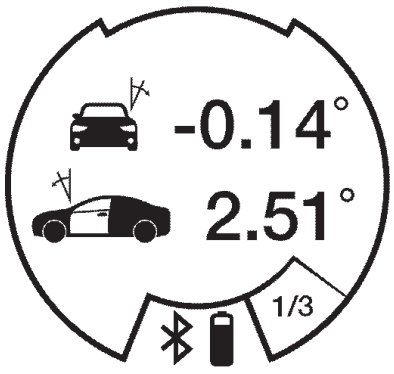


Door Angle

Window Shake



Friction Effect



Hinge Tip

Finished Measurement

Figure 2. SpeedPod device screens in use for single measurement values

SpeedPod has optional modules to extract specific metrics from the measured movement:

Closing Speed: Speed of a door at a specific point along its trajectory. Includes methods to determine minimum closing speed using both latched and not-latched trials. This metric is available in any version of SpeedPod

Window Shake: As part of a frameless module, the system can measure the amplitude of window vibration while unlatching or opening. Typically used on frameless doors.

Door Angle: Angle of door travel. Typically used to measure detent angles of the door system. Available in the trajectory module.

Friction Effect: Loss of kinetic energy during travel. Available in the trajectory module.

Hinge Tip: Orientation of the hinge axis versus gravity. Available in the trajectory module.

Spring: The maximum speed of a door or hood during unlatching. Available in the latch module.

3.2 Process Efficiency

SpeedPod has built-in methods to perform measurements for application driven objectives. The selection will minimize the measurement time, all while meeting very specific criteria to obtain the desired result. The device will show a large finish flag on the display to indicate the completion of the measurement to the operator.

All modes are available for any of the metrics that SpeedPod technology can measure.

EZ Mode: Instant measurements with low-setup requirements—no need for tolerances. The individual measurements are shown on the display.

Go/No-go Mode: A mode focused on the shortest possible cycle time. As soon as the measurement data confirms that the door is in or out of tolerance, the measurement is flagged as completed. The user is shown the finish flag to indicate a successfully completed measurement. This configuration is ideal for pass/fail applications.

True Value Mode: The most accurate and traceable method for measuring absolute minimum closing speed and a variety of other metrics. Only when all criteria, such as gap mode or number of samples is reached, will the measurement be flagged as completed.

3.3 Performance Enhancement Functions

Multiple features will accommodate and reduce any variation in the measurement due to user or door variation and enable button-free operation.

Smart Tolerances and Settings: Value and attempt limits to end a measurement session quickly and immediately set the pass/fail status.

Gap Mode: Measurement mode that requires a high not latched measurement and a low latched measurement. As soon as the values are within defined range of each other or Gap Tolerance, the system will end the measurement automatically. The result is the average between the highest not latched and lowest latched measurement.

Multi-gap Mode: This can be set to average multiple results and statistically improve the repeatability for a single operator, at the same time, enhancing the reproducibility between different operators.

Minimum Number of Samples: Within one session, the system can require multiple acquisitions and establish an average, minimum, or maximum value for the final result.

Gray zone: A gray zone can be defined so that if the final measurement is close to the tolerance, an additional measurement is requested to decrease the uncertainty band and avoid false positives and false negatives.

Button-Free Latched/Not Latched: SpeedPod will automatically determine if the door was latched or not latched after a closing movement without any required interaction or button operation from the user. The standard detection algorithm can work in most cases. For a few special cases, a built-in teaching mode can determine the optimal settings for any given door.

Latch Profile: Based on a one-time sampling procedure, the algorithm will teach itself how to recognize difference between Latched and not latched cases. This setting are saved in the profile and can be recalled at any point in time.

3.4 Accuracy, Resolution, and Range

Parameter	Range	Resolution	Accuracy
Speed (Standard Range)	10 to 2200 mm/s	1 mm/s	< 1.5%
Speed (Extended Range)	10 to 8300 mm/s	1 mm/s	< 1.5%
Vibration	± 160 m/s²	0.05 m/s²	< 1.5 %
Door Angle	0 to 90°	0.1°	< 0.8 %

4. Software and Data Logging

4.1 Data Logging Software

SpeedPod's wireless capabilities, in combination with application software, provide a reliable platform for inspection requirements from product sampling to 100% inline inspection to door system analysis.

These additional software products are available from EZMetrology to extend the capabilities of SpeedPod:

Data Logging Module: Enables data logging to text file using MyPod software. This logging can be used to record continuous raw data to reconstruct the full trajectory. The device can also be configured to log only the key metrics values to file. The details of the file content are explained in this document.

IOManager: Software solution for recording SpeedPod raw data. This will show speed or acceleration as a function of time. The software incorporates many signal processing options to assist in extracting the right data or characteristics such as speed in function of door angle. This platform can be simultaneously coupled with additional EZMetrology Pod technology to include a variety of other metrics, for example, pressure or force. This is a popular solution for engineering or analysis.

Production Line Solution (PLS): Ideal for repetitive measurements with the least amount of user interaction. The application itself does not require any user interaction as the inspection process is fully automated. The software will be initiated by scanning an ID, such as the VIN, and use this to determine the vehicle type, model and associated door profiles. When the inspection routine is complete, a report is made on this vehicle which can be saved and displayed locally, in a remote database or as a cloud report.

4.2 MyPod: Pod Management Software

Configuration software to set up the device with preferred settings such as profiles, units, & tolerances.

4.2.1 Personalization
Settings that allow you to configure the device for your specific habits and conventions. This includes units, connections, logging...

4.2.2 Profiles
Programmable user profiles can quickly adapt the device for a specific door or use case. The profile contains information on measurement mode, its settings, and the use case. A profile can be recalled and activated within seconds.

A collection of profiles can be produced to support an entire inventory of vehicles. Typical settings include:

- Tolerances
- Measurement Metrics
- Measurement Mode
- Door Radius

4.2.3 Verification
In combination with the SpeedBay verification tool, MyPod can confirm the performance of the device at any chosen time interval.

Figure 3. MyPod software screen for device setup

4.3 Computer Requirements

Minimum Hardware Requirements	
Operating System	Windows 10
Microprocessor	Intel® i5 Core or equivalent
Memory	8 GB RAM
Hard Drive	SSD with 2.5 GB available for MyPod Software install and use
USB 2.0 Ports	2
Wireless Connectivity	Bluetooth

4.4 Storage & Export

Parameter	Value
Onboard Non-Volatile Memory	32 GB
Discrete Data	Approx. 160M samples
Sensor Data	Approx. 50K Recordings
Export Format	CSV

4.5 Discrete Data

```
Date and Time,Vehicle Identification Number,Door Location,Profile Name,Closing Speed,Units, Door Radius,
Evaluation, Latched/Not Latched
11/29/2023 15:22,123456,RightRear,DEMO,1.019,m/s,1000,Pass, Latched
11/29/2023 15:22,123456,RightRear,DEMO,1.133,m/s,1000,Pass, Latched
```

Figure 4. Closing Speed measurement example with CSV output

```
Date and Time,Vehicle Identification Number,Door Location,Profile Name,Current X Value,Current Y Value,
Average X Value, Average Y Value,Angle Units,Evaluation, Latched/Not Latched
11/29/2023 3:31,5T54R2,LeftFront,DEMO,-3.2,-2,-3.2,-2,Degrees,Fail, Latched
11/29/2023 3:31,5T54R2,LeftFront,DEMO,-3.3,-1.9,-3.3,-1.9,Degrees,Fail, Latched
```

Figure 5. Hinge Tip measurement example with CSV output

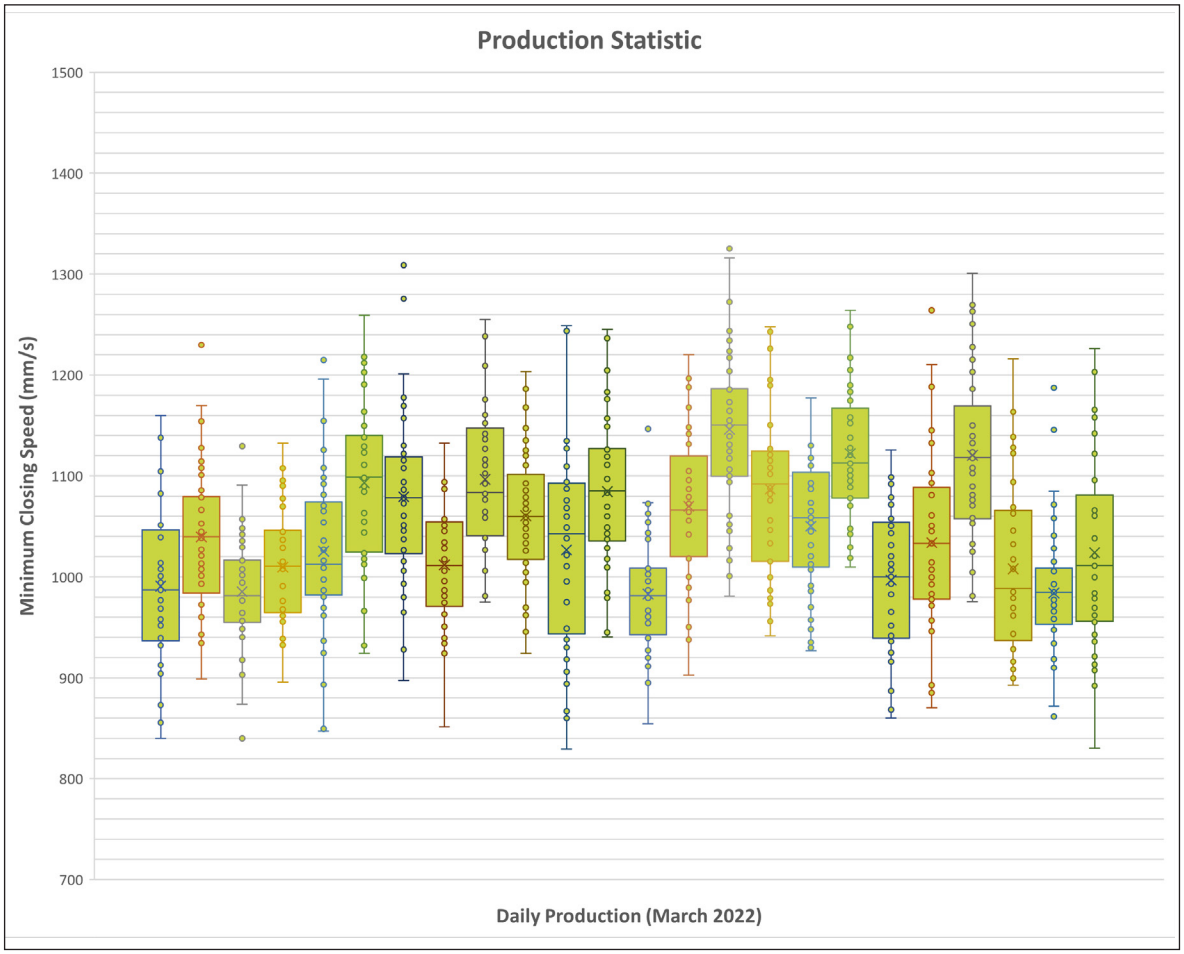


Figure 6. Example of Box and Whisker plot with discrete data export and Microsoft® Excel

4.6 Sensor Data

```
Time,GyroX, GyroY, GyroZ, AccelX, AccelY, AccelZ
0.0000, 0.03051,-0.06109,-0.12203,-0.02197,-0.99552,-0.00244
0.0025,-0.18305, 0.00762,-0.15254,-0.02343,-0.99796, 0.00097
0.0050,-0.11444,-0.03051, 0.16782,-0.02148,-0.99259,-0.00097
0.0075,-0.13736,-0.09154, 0.23648,-0.02392,-0.99356,-0.00634
```

Figure 7. Manually recorded hinged door trajectory example and CSV output

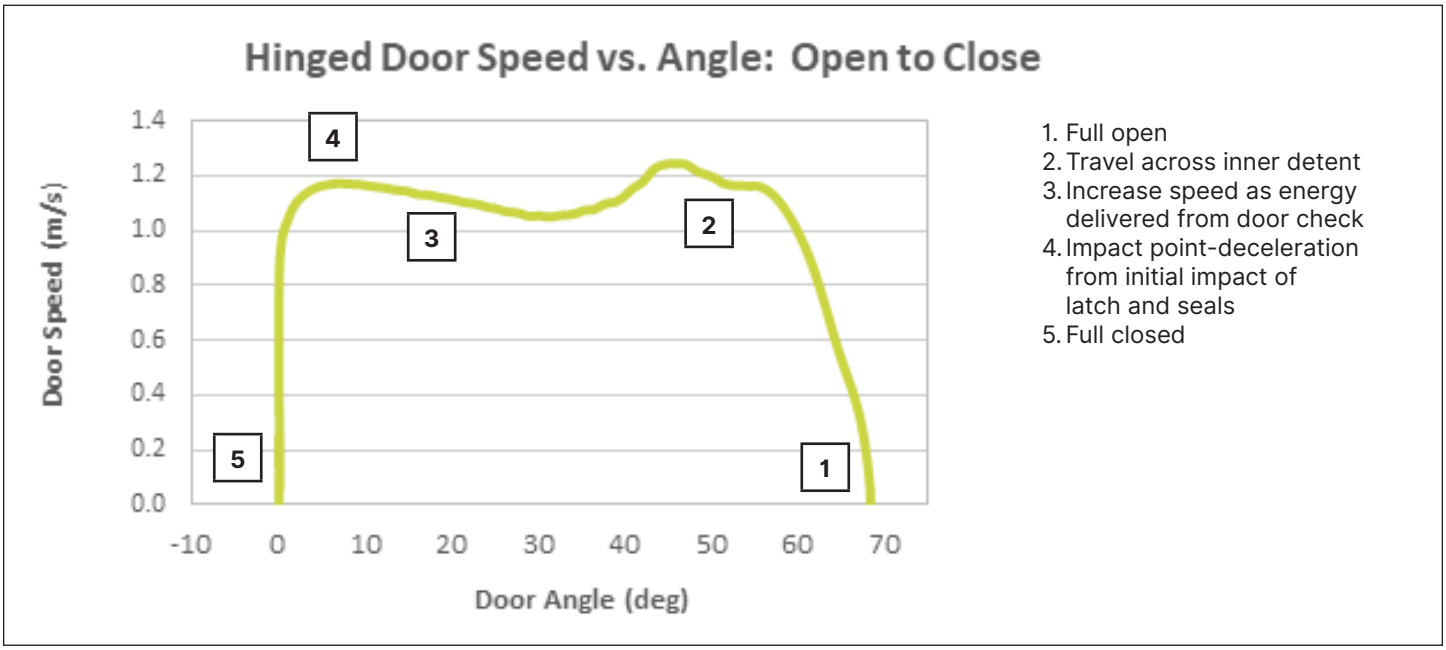


Figure 8. Trend Chart of Hinged Door Closing Speed vs. Angle from export of data into Microsoft® Excel

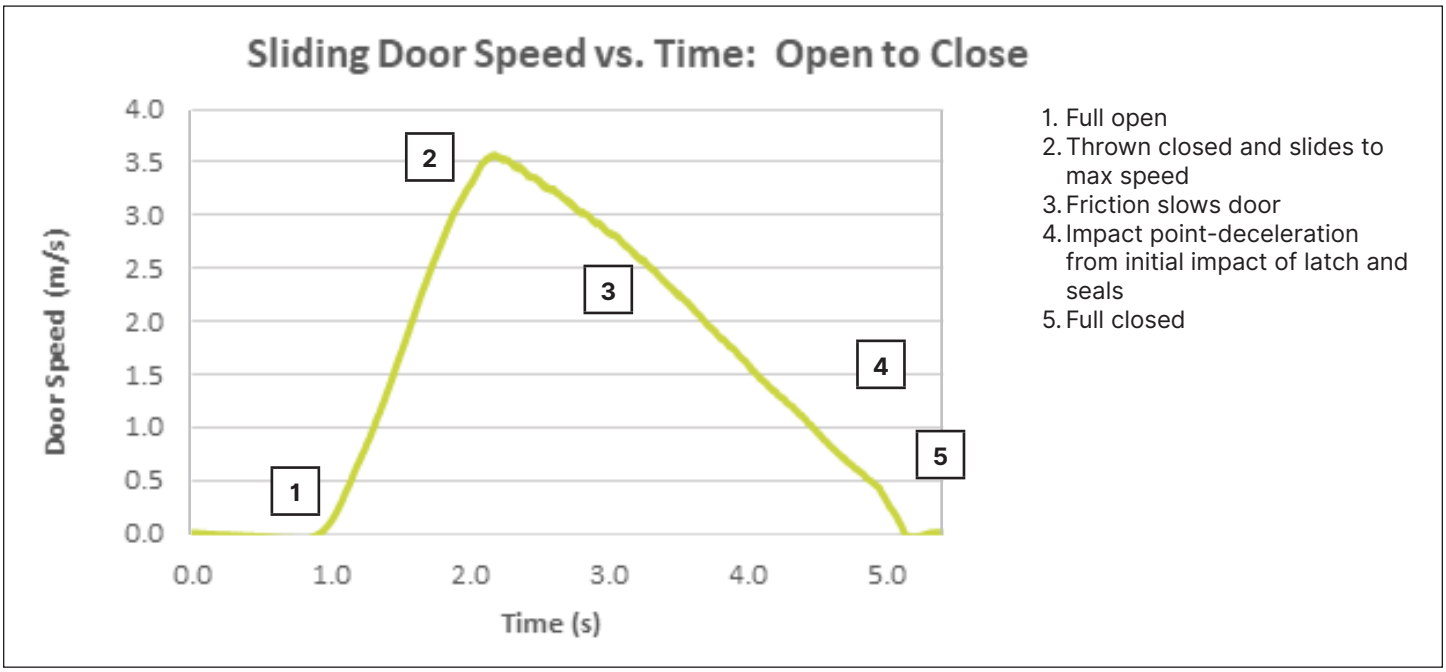


Figure 9. Trend Chart of Sliding Door Speed vs. Time from export of data into Microsoft® Excel

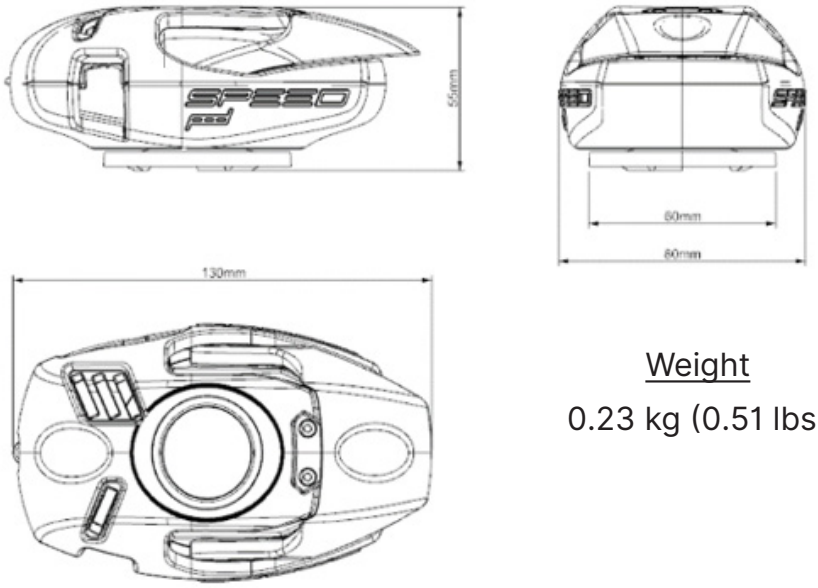
4.7 Recording Sampling Rate

Data Sampling Rate[1] (Hz)	Max. Recording Time (s)
25	80
50	40
100	20
200	10
400	5
800	2.5

[1] Configuration of sampling rate available in Manual Recording; default value is 400 Hz
Limited to 200 Hz with EZMetrology IOManager

5. General Specifications

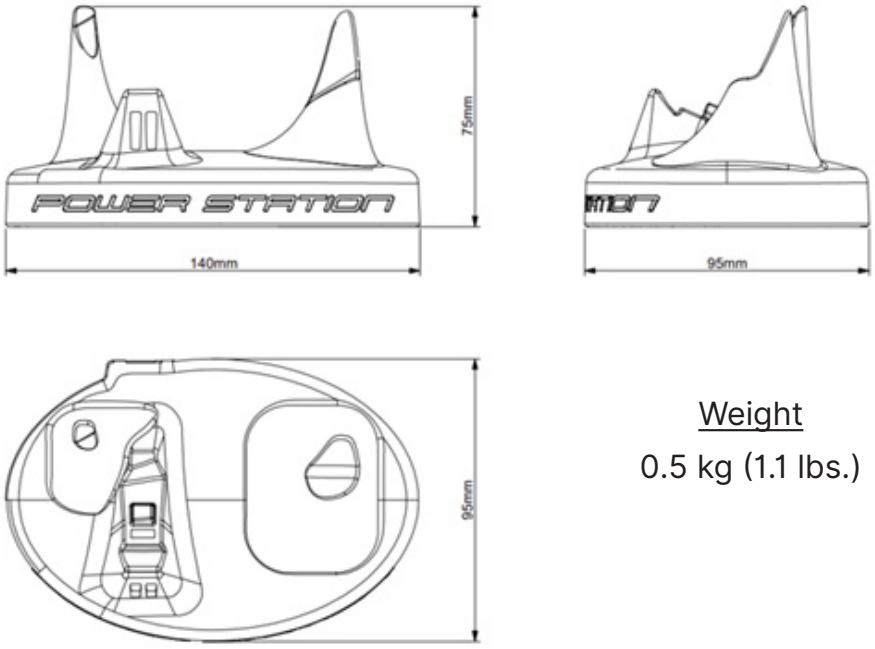
5.1 Dimensions and Weight



Weight

0.23 kg (0.51 lbs)

Figure 9. SpeedPod height, width, length, and weight



Weight

0.5 kg (1.1 lbs.)

Figure 10. Power Station height, width, length, and weight

5.2 Power Specifications

Parameter		Value
Batteries		2 independent Li-Ion, rechargeable; 1 battery removable
Voltage		3.7 V
Current Capacity		650 mAh
Power Capacity		2.5 Wh
Operation on Single Full Charge (normal use)		8 hours
Power Station Fast Charging	Requirements	110 - 210 VAC to 5 VDC, 6W
	0 to 40%	1 hour
	0 to 100%	< 3 hours

5.3 Connectivity

Parameter		Description
Bluetooth	Version	v4.2 + BR/EDR
	Transmit Power	Max. +3 dBm (limited by firmware)
	Receiver Sensitivity	-88dBm (min); -89 dBm (typical); -90 dBm (max)
	Range	10 meters, line of sight
	Transmitter/Receiver	Integrated chip antenna or U. FL connector
Wi-Fi		802.11 /b/g/n
USB-C		v3.1 Gen 2

5.4 EMC & Certification

Wireless Certifying Organization	Certificate/Identifier Number
Bluetooth Launch Studio	D051055
Canada ISED (RSS-247 Issue 2)	B20070614
China CMIIT	2020DP2713
Europe CE (EMC Directive 2014/53/EU)	B2004079
FCC (Part 15c)	2AC7Z-ESP32WROOM32E
Japan MIC	217-204070
Korea KCC	R-C-es5-ESP32WROOM32E
Taiwan NCC	CCAK21Y10020T0
Wi-Fi Alliance Interoperability	WFA97858

5.5 Environmental & Operational Sensitivity

Parameter	Value
Orientation Sensitivity[1]	0.50%
Placement Sensitivity[2]	0.46%
Operating Temperature (Continuous Operation)	0 to 50°C
Temperature Measurement Sensitivity	0.12% per 10°C
Storage Temperature	-20°C to +60°C

[1] Average measurement variation for SpeedPod mounted on car door and rotated between 0 and 360°
[2] Average measurement variation for SpeedPod mounted on car door for matrix of 2 different radii from hinge and 3 different vertical positions along metal + window door assembly

5.6 Reliability

Parameter		Value
Drop Resistance		1.8 m (6 ft)
Glass Screen Shatter Resistance		> 300 N
Suction Cup System[3]	Holding Force	120 N
	Holding Time	3 hours
	Durability	> 100,000 cycles

[3] Suction cup replacement kit available

Figure 11. Single-action lever to mount and release SpeedPod with patented suction cup

5.7 Parts and Materials

Figure 14. Exploded view of SpeedPod

	Component	Material
1	**Protective Cover**	Silicone (40 Shore A)
2	**Housing**	ABS
3	**Display Screen Transparent Cover**	Mineral Glass
4	**Retainer Ring**	Anodized Aluminum
5	**Suction Cup Lever**	Nylon
6	**Suction Cup**	Polyurethane
7	**Power Station Cover**	ABS

6. Purchase and Service

6.1 Kit Content

SpeedPod

Power Station

USB A to C

- 1 m / 3 ft

Wrist Strap

Rugged Transport Case with Custom Foam Insert

- Height x Width x Length: 30 x 25 x 12 cm
- Weight: 2.32 kg

MyPod Software

- 1 MyPod program and license provided on SD card

Wall Mount Adapter

- 110-240VAC to 5VDC 6W

Type A (NEMA 1-15 U.S. 2 pin)	North America
Type C (CEE 7/16 Europlug)	Europe
Type G (BS 1363 UK)	United Kingdom
Type I (Australian AS/NZS 3112)	Australia

Figure 15. SpeedPod kit with accessories

6.2 Optional Modules

The basic functionality can be enhanced with modules to widen the applications or to satisfy a requirement

Universal Hinge Module : Enables to measure non vertical hinged doors such as liftgates, frunks

Trajectory Module : Enable to measure hinge tip, friction and door angle

Latch Module: Includes Spring test

Data Logging Module: Enable the capability to log raw or metrics data to SD card or Computer

Extended Range Module: Increases the maximum measurement speed from 2.2 m/s to 8.3 m/s

6.3 SpeedBay Verification Tool

EZMetrology offers SpeedBay — a convenient tool for onsite verification that can be used by customers at any time to ensure SpeedPod performance is within tolerances.

Article #31300 SpeedBay

6.4 Calibration Service

All devices are initially calibrated at EZMetrology's Calibration Lab. The individual device serial numbers, procedures, and necessary information for traceability are listed in the calibration documents for each device. It is recommended to return the devices to EZMetrology for recalibration after one year. Onsite calibration of SpeedPod devices is an additional option that can be requested.

6.5 Replacement Kits

Article #31003
SpeedPod Suction Cup & Lever Replacement Kit

Article #31004
SpeedPod Protective Cover Kit

6.6 Training

Online and onsite training options for SpeedPod are available from our technical experts. Any training class is adapted to meet the number of participants and the objective of the envisioned usages in the customer's environment.

6.7 Support, Protect and Care

All SpeedPod devices are covered by our 1 year Protect and Care Program. The program covers access software updates, access to support and covers the device for any malfunction. Details of the coverage and exceptions can be found in the respective Protect and Care policy. The program can be extended after the initial coverage period ends.

6.8 Other Pods

Visit our website below for information regarding additional products in the EZMetrology Pod family

ForcePod

PressurePod

SensorPod

6.9 Order & Contact Information

Telephone: +1 248 861 2600
Email: info@ezmetrology.com
Website: www.ezmetrology.com

References: TELD003 Datasheet, TELC003 Wireless Certificate, TELC001 Certificate of Conformity, TELD002 Performance Data, TELC002 Durability Certificate, TELD001 Correlation with EZSpeed